

MULTIPLE COIL DATA TRANSMISSION SYSTEM

PRIORITY ENTITLEMENT

[0001] This application is entitled to priority based on Provisional Patent Application Ser. No. 61/418,501 filed on Dec. 1, 2010, which is incorporated herein for all purposes by this reference. This application and the Provisional patent application have at least one common inventor.

TECHNICAL FIELD

[0002] The invention relates to coupled inductor systems. More particularly, the invention relates to multiple coil systems for use in wireless data transfer applications. In preferred embodiments, the invention relates to the wireless transmission of data among coupled inductor coils. In preferred embodiments employed in wireless power transfer applications, the invention relates to the more efficient utilization of energy resources.

BACKGROUND OF THE INVENTION

[0003] Existing power transmission systems utilize coupled inductor coils to transfer power wirelessly. Some of the systems known in the art also transmit data as well as power. Typically such systems use high-inductance coils (on the order of micro-Henries) and switch at low frequencies (hundreds of kHz). These systems are somewhat effective for transmitting power for apparatus such as battery chargers, AC/DC converters, and remote devices, but are not capable of transmitting high-bandwidth data. Effective implementation of wireless data transmission systems using coupled inductors faces several challenges. Among them is the problem of tuning the elements of the system to optimize transmission frequency in the presence of parasitic elements that cause ringing or otherwise distort the data signal. Additional problems encountered include, managing the peak currents in the inductors, and reliably sending and receiving data in the presence of active inductive power transmission. Another significant challenge is maintaining maximum bandwidth in the presence of varying system conditions such as temperature, coil misalignment, and coil separation.

[0004] Due to these and other problems and potential problems, improved coupled inductor data and/or power transmission systems would be useful and advantageous contributions to the arts.

SUMMARY OF THE INVENTION

[0005] In carrying out the principles of the present invention, in accordance with preferred embodiments, the invention provides advances in the arts with novel apparatus directed to the transfer of data and/or power using inductive couplings. In preferred embodiments, systems include capabilities for data and/or power transfer. Preferably, the coupled coils of systems of the invention are not permanently physically interconnected.

[0006] According to aspects of the invention, examples of preferred embodiments include multiple coil systems having at least a primary coil, and a secondary coil for coupling with the primary coil. The primary and secondary coils are preferably not permanently physically affixed to one another and are interchangeable, e.g., a secondary coil can preferably be removed and replaced with a different secondary coil. When positioned in proximity, the primary and secondary coils are

electromagnetically, but not physically, coupled such that one or more signals may be passed between the coils.

[0007] According to aspects of the invention, in examples of preferred embodiments, a multiple coil system for wireless data transmission includes multiple primary side coils connected such that they may be driven independently with a driver signal. One or more suitable secondary coils are positioned in proximity to the primary coils for receiving the signal inductively so that the signal may be wirelessly transferred from one or more of the primary coils to one or more secondary coil.

[0008] According to aspects of the invention, in examples of preferred embodiments, systems for wireless data transmission includes multiple primary coils connected with circuitry for sensing secondary coil proximity and for operating to responsively transmit a signal to detected secondary coils located in proximity with the primary coils.

[0009] According to aspects of the invention, preferred embodiments of a system for multiple coil wireless data transmission include at least one coil equipped with switchable taps that may be selected for changing the frequency characteristics of the coil.

[0010] According to another aspect of the invention, preferred embodiments of a system for multiple coil wireless data transmission include at least one coil connected with a switchable capacitor network that may be used for selectively changing the frequency characteristics of the coil.

[0011] According to an additional aspect of the invention, an example of a preferred multiple coil data transfer system according to the invention includes at least one primary coil connected to a circuit for transmitting data. A secondary coil is provided, along with a circuit for receiving data. In the system, at least one primary coil and at least one secondary coil are adapted for inductively coupling for data transfer. In order to facilitate this, the primary side includes circuitry for selecting at least one primary coil for transmitting data based on sensed proximity to a secondary coil.

[0012] The invention has advantages including but not limited to one or more of, improved coupled coil system bandwidth, improved data integrity, and reduced costs. These and other potential advantageous, features, and benefits of the present invention can be understood by one skilled in the arts upon careful consideration of the detailed description of representative embodiments of the invention in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present invention will be more clearly understood from consideration of the following detailed description and drawings in which:

[0014] FIG. 1 is a simplified schematic diagram of a coupled inductor system illustrating an example of a preferred embodiment of the invention;

[0015] FIG. 2 is a schematic diagram of an example of a preferred embodiment of a multiple coil system according to the invention; and

[0016] FIG. 3 is a simplified schematic view illustrating an example of a preferred embodiment of a multiple coil system according to the invention.

[0017] References in the detailed description correspond to like references in the various drawings unless otherwise noted. Descriptive and directional terms used in the written description such as right, left, back, top, bottom, upper, side, et cetera, refer to the drawings themselves as laid out on the